PATENT SPECIFICATION

620,701

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No. 21094/46

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COMPLETE SPECIFICATION

Improvements relating to Pallets for Use with Load Handling Trucks

I, NORMAN LEE CAHNERS, of 121, Cabot Street, Newton, Massachusetts, United States of America, a citizen of the United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to pallets for use with load handling trucks and is concerned specifically with expandable pallets. The term expandable is used to denote platforms economically adapted for one shipment use, to be thereafter discarded or thrown away. Their cost is so small as to be absorbable as a transportation expense instead of representing a capital investment.

Use of portable platforms, commonly referred to as pallets and skids, has been recognized as a source of substantial reduction in the labour cost involved in transporting commodities, particularly small items of uniform size and weight, and has come into increasing use even where substantial capital investment in pallets is required, as with durable wood and metal pallets, but the use of such pallets has serious limitations. In the first place durable platforms often weight as much as 100 pounds and therefore add a substantial amount to the cost of transportation. Secondly, some arrangement must be made for their return—with added transportation cost—or disposal at their destination. These obstacles have not been heretofore successfully overcome to my knowledge, mainly because the strength requirements of a general use pallet are now found only in heavy wood and steel constructions.

This invention has for an object the provision of pallets, having the requisite strength for general use, which are so inexpensive to begin with that they are inherently economically suitable for discard after being once used, and which are so light in weight that their addition to transportation cost is practically negligible.

According to the present invention a portable materials handling pallet adapted for use in lift trunk operations comprises a platform, e.g. of rectangular shape, and a plurality of tubular supporting members spaced apart from one another beneath said platform for supporting the same and consisting of non-metallic light-weight material in the form of sheets or webs, preferably of fibreboard, paper or the like, each of which supporting members extends both laterally and longitudinally of said platform a distance at least as great as its height, and which supporting members form open spaces between them or within themselves of greater width than height adequate for reception of the load handling forks of a lifting truck beneath said platform.

In the preferred form of structure the open spaces between the supporting members are open-bottomed, and they may form mutually intersecting passageways which are accessible from four sides beneath the pallet.

It has previously been proposed to make a platform for supporting goods in transportation which consists of a corrugated steel platform element on which the goods can be packed, and two supporting members bent up from sheet steel as described in United States Patent Specification No. 1,897,593, but it will be appreciated that the present invention is directed to the manufacture of pallets from non-metallic lightweight materials such as fibreboard or paper, and that according to the present invention the supporting members are not merely bent

up and their sides attached to the underside of the platform, but are made of tubular elements, the tubular elements being much stronger for a given kind of material than mere flat sides which are caused to adhere to the underside of the platform.

Pallets according to this invention provide, when desired, in addition to the above, the advantageous feature of ready adaptation to use by low lift as well as by high lift fork trucks.

With regard to the latter, counterbalanced high lift fork lift trucks which operate on the cantilever principle may and often do have fairly thin forks so that platforms used therewith may be low, with passageways of just sufficient height to permit ingress of the forks thereunder, sometimes as little as $\frac{3}{4}$". On the contary, manually or power operated low lift trucks have wheels at the forward ends of the forks which are designed to be lowered after the forks are positioned beneath the platform to lift the platform with respect to the floor or other supporting surface. Forks of these trucks require about 3" clearance. As the height of the platform is increased to accommodate such forks, resistance to lateral collapse is greatly decreased, and compressive strength becomes an increased problem, particularly because the passageways must retain sufficient width to accommodate the width of conventional forks.

Pallets of this invention despite their low cost and light weight may have adequate passageway height to accommodate lift forks of low lift trucks and still have adequate resistance to lateral collapse and sufficient compressive strength in a vertical direction.

Another desirable feature of pallets of this invention in connection with their use with low lift fork trucks is that the passageways may be open-bottomed and offer no barrier to the lowering of the wheels of low lift trucks.

With respect to four-way entry, incorporation of this feature necessarily reduces the area of the pallet beneath which direct support can be provided, thus decreasing resistance to vertical and lateral colapse. Nevertheless, the structure of pallets of this invention permits low cost, lightweight construction for four-way entry and the structure may still have, even when the passageways are of a height to accommodate low lift truck forks or platform trucks, adequate resistance to lateral collapse and compressive strength in a vertical direction.

The above and other advantages of platforms of this invention will be more fully understood when considered in connection with a description of forms of structure embodying the invention and shown by way of example in the accompanying drawings in which

Fig. 1 is a perspective view of a preferred pallet of the invention, having a preferred type of supporting member;

Fig. 2 is a bottom plan view of the device of Fig. 1;

Fig. 3 is a front elevation of the device of Fig. 1;

Fig. 4 is a vertical cross-section along the line 4—4 of Fig. 1;

Fig. 5 is a perspective view, broken away for purposes of clarity, of a modified form of one of the supporting members utilized in the construction of Figs. 1 to 4;

Fig. 6 is an elevation, shown partly in section, of a further modified form of one of the supporting members utilized in the constructions of Figs. 1 to 4;

Figs. 7 and 8 are perspective views of still further modifications;

Fig. 9 is a bottom plan view of a modified form of pallet embodying the invention;

Fig. 10 is a perspective view of another modified form of pallet.

Fig. 11 is a perspective view of one of the supporting members shown in Fig. 10, broken away to indicate variation in length;

Fig. 12 is a further modified form of pallet adapted for two-way instead of four-way entry;

Figs. 13, 14, 15 and 16 are further modified forms of supporting members which may be utilized in the construction of Fig. 10;

Fig. 17 is a further modified form of the invention;

Fig. 18 is a detailed modification of the device shown in Fig. 17;

Fig. 19 is an end elevation of the device of Fig. 17 showing how the pallet may be collapsed before assembly;

Fig. 20 is a perspective view of a two-way platform utilizing an elongated element of the type shown in Fig. 16;

Fig. 21 is a plan of a blank adapted to form a four-way platform;

Figs. 22 and 23 are end and side elevations respectively of the pallet formed from the blank of Fig. 21; and

Figs. 24 and 25 are further modified forms of pallets of this invention.

Pallets of this invention comprise an elevated platform comprising a flat sheet of suitable non-metallic lightweight material, such as solid fiberboard, corrugated paper, paper board, plywood, veneer or pressed wood.

These platforms are supported by a plurality of spaced supporting members

which define therebetween on each of two or each of four sides of the pallet, depending upon whether the pallet is adapted for two-way or four-way use, openings for accommodating the forks of lift trucks. The supporting members are, in each instance, hollow tubular elements with the bores of the tubes extending, in the preferred case, in a direction normal to the plane of the platform and in other cases in a direction parallel to the plane of the platform.

In the preferred case the tubular elements are cylinders but the shape may be varied, although as the shape approaches a rectangular tube, internal reinforcing elements are essential to provide the strength against lateral collapse required for supporting the desired loads. The internal reinforcements take a variety of forms as will be hereinafter described, depending on whether the supporting members have their bores extending normal or parallel to the plane of the platform.

Again, in the preferred forms of supporting member, each supporting member is an integral unit of fiberboard or other material, for example, a cylindrical paper tube or a sheet of material folded in such manner as to provide, in addition to vertically extending portions, integral internal reinforcements, reinforcing the vertically extending portions against lateral collapse.

The simplest form of device is shown in Figs. 1 to 4. Here the device has an elevated plane platform 10 comprising a thin flat sheet of solid fiberboard, corrugated paper, chipboard, paperboard, plywood, veneer, pressed wood, or other suitable non-metallic sheet material, preferably double-faced corrugated paper having a thickness of approximately $\frac{3}{8}$" solid fiberboard. The size of the platform may be conveniently 32" × 48". The platform is permanently elevated by a series of supporting members comprising tubular elements, shown in the drawings as hollow cylinders 14 having inside and outside diameters exceeding their height, positioned as shown with the axes of their bores disposed normal to the plane of the platform. Preferably, the hollow cylinders 14 are spirally or convolute wound fiberboard or chipboard formed on the principle of mailing tubes. For a 32" × 48" platform such as that shown, I have found that tubes having approximately the following dimensions: outside diameter—6", wall thickness—$\frac{3}{8}$" to $\frac{1}{2}$", and height—$3\frac{1}{2}$" to 4", preferably $3\frac{3}{4}$", give adequate strength and resistance. These tubular elements are adhesively or otherwise affixed along their top rims to the undersurface of the platform 10 to provide, in the case of the platform in Fig. 1, nine supporting members in transverse and longitudinal rows of three each forming therebetween openings 15, 16, 17, 18, 19, 20, 21 and 22 leading to two intersecting pairs of open-bottomed parallel passageways. As indicated, with a platform and supports of the dimensions given, it is desirable to set the rows along the shorter sides of the platform about 3" in from the platform edges. This reduces the platform span between the supporting members in a longitudinal direction. As thus set in, the spans between the tubular elements in the 48" direction will be 12" each, whereas in the 32" direction they will be 7" each. The height of the openings and passageways will be equivalent to the height of the tubular elements, that is $3\frac{3}{4}$". The openings thus have adequate width and height to accommodate the forks of conventional lift trucks, but the openings 17, 18, 21, 22 on the longer sides conventionally used for lifting, being slightly wider, that is 12", permit less accuracy in approach on those sides. Four-way operation is, moreover, permitted by the presence of the intersecting 7" parallel passageways leading from openings 15, 16, 19, 20 and running longitudinally of the platform.

By the use of the hollow tubular members, therefore, support is provided over a relatively large area of the platform to minimize the intervening span of the platform, but the expense is kept low due both to the hollow nature of the tubular elements and to their cylindrical shape. With such a structure, I have found that the platform 10 need not have the rigidity of wood planking; but may be of relatively lightweight material such as the corrugated paper previously suggested, it being unnecessary for the material constituting the spans to have such rigidity because the spacing of the supporting members is such that either individual units of the load will extend across the spans and be directly supported by two or more supporting members or else the weight of units directly supported by the supporting members so anchor the corrugated paper and tension the material constituting the spans that intervening units not directly supported by the supporting members do not collapse the platform. Thus, in the platform shown in the drawing, in the 32" direction, the aggregate of the maximum widths (outside diameters) of the supporting members is $3 \times 6" = 18"$, which constitutes more than one-half of the lateral 32" dimension of the platform; whereas in the 48" direction, the aggregate of the maximum

lengths (outside diameters) of the supporting members is 18" which constitutes exactly half of the distance between the centers of the outside rows of supporting members. At the same time, the extent of each supporting member laterally and longitudinally, being greater than its height, provides good resistance to toppling.

As previously stated, highly satisfactory supporting members may be formed of fiberboard and may consist, for example, of adhesively laminated convolutions formed from seven 5½" widths of paper wound in overlapping relation on a mandrel spirally of the axis of the tube, for example at an angle of about 30° to a plane perpendicular to the axis, to a wall thickness of ⅛" to ¼", each paper sheet having a thickness of .020" to 0.038", the whole when transversely cut forming one-piece open-ended units having endless walls of continuous laminated sheet material. Such tubes in ⅛" thickness, 3¼" height and 6" outside diameter weigh something less than 5 ounces each, so that a total platform can be built which weighs only 6 to 6½ pounds even when the wall thickness of the supporting members is ¼". Each individual ⅛" thick unit has been found to withstand a static load up to 1500 pounds without collapsing, and a platform such as shown in Fig. 1 and described herein, properly loaded, has withstood, without collapse, a static load of over 5 tons, a tremendous and surprising carrying capacity considering the amount and character of material contained in the structure, and considering that they can be made available to shippers at about one-fifth to one-eighth the cost of wooden platforms of the type now available which do not even provide four-way entry. It is contemplated, however, that other fibrous or non-fibrous, non-metallic lightweight sheet material or resin bonded or molded material can be substituted for the fiberboard where cost is not a major factor.

The outstanding utility of pallets of this invention thus results from their unique structure which requires an exceedingly low amount and weight of material per unit of load carrying capacity. Usually, fork lift pallets of this invention have a ratio of static load carrying capacity in pounds to total weight in pounds of the order of 1500 to 1 or more, and have overall weights of the order of 6 to 8 pounds and not exceeding about 12 pounds. In general, the tubular elements have outside wall thicknesses, at least at the points of minimum thickness, of not more than one-eighth of their greatest outside dimension.

With respect to the tubular elements, for minimum cost and minimum material use for a given strength, particularly against lateral collapse, cylinders are especially recommended, but other forms, with probable increased cost or weight, may be utilized. In the absence of reinforcing elements, as hereinafter described, the tubular elements should, however, for maximum resistance to lateral collapse, have for a given wall thickness at least substantially the resistance to lateral collapse inherent in tubular elements of uniform or non-uniform circular cross-section or diameter having the same wall thickness, and include tubular walls having continuously curved or at least intermittently curved or reversely curved or high polygonal cross-sections arranged, preferably, like a cylinder, symmetrically about the axis or substantially so. If the tubular elements are rectangular in shape, reinforcing elements are essential to avert lateral collapse.

The compressive and lateral strength of pallets of this invention may be varied merely by varying the thickness of the walls of the supporting members 14. The invention therefore provides a pallet which can be readily modified in cost to suit particular requirements.

In some cases where unusual amounts of pushing and sliding may occur, or where stacking is contemplated, the supporting members may be provided with bases 26 as of chipboard or other material, adhesively secured across the bottom face of each tube, as shown in Fig. 5. In some instances these base members 26 may be waterproofed as by impregnating the material or, if desired, the supporting members may be capped with a metallic or non-metallic flanged cap 28 such as shown in Fig. 6. These act also to improve resistance to lateral collapse or may be useful to resist water damage.

For unusually heavy duty, a pallet such as that of Fig. 1 may be given added capacity or margin of safety, by fitting into the tubular members or hollow sleeves, internal reinforcing elements. For example, as shown in Fig. 7, a strip 30 of fiberboard, corrugated paper, chipboard, pressed wood, wood, plywood or other strengthening material of substantially less volume than the bore of the sleeve and of dissimilar shape, and for example of ⅛" or more thickness depending upon the reinforcement desired, may be fitted, wedged, or adhesively or otherwise secured diametrically across the sleeve. Or an X-shaped element 32 of slotted intermeshed and interlocked strips may be similarly placed, as shown in Fig. 8. These strips can be made of the same

type of materials as the element 30 of Fig. 7.

In some cases, decidedly greater support may be secured by utilizing more than nine tubular elements. In Fig. 9, thirteen are shown, each corner containing a supporting member composed of two hollow cylinders aligned along the long dimension of the platform. If these elements 14 are of identical size with those used in the platform of Fig. 1, the width of the lateral parallel passageways will be cut down from 12" to 9" each, but will remain adequate for normal fork lift truck use.

Figs. 10, 11 and 12 show a modified form of pallet wherein the supporting members 40 are formed of corrugated fiberboard, each supporting member being a unit as illustrated in Fig. 11, having six vertically extending portions.

The device 40 is formed by scoring and folding a sheet of corrugated paper so that it has a base portion 42 and lateral extensions identical on both sides, including successively a side upright 43, a top section 44, an inside upright 45, an inside bottom section 46, a second outer upright 47 and a diagonal truss 48. In this construction the corrugations are arranged to extend vertically in the upright sides of the supporting member.

The reinforcing element of Fig. 11, after folding, may be fastened in folded position by application of a tape 48, although this is optional.

Where a 4-way platform is desired, such as shown in Fig. 10, nine of these units, of suitable length, are adhesively or otherwise affixed to the under side of the platform.

Fig. 12 shows a 2-way structure wherein the supporting members 40 of Fig. 11 extend the entire length of the platform 10 and are stapled thereto.

Figs. 13, 14 and 15 show modified forms of supporting members that may be substituted for the supporting members 40 shown in Fig. 10. Each of these supporting members is of generally rectangular outside shape. The one shown in Fig. 13 comprises a strip of fiberboard or corrugated paper formed into a hollow tube 50 having a double lapped side wall 51. Set internally of the sleeve 50 are slotted and intermeshed reinforcing elements 52 and 53 which may be of fiberboard, wood or other suitable material. This unit of Fig. 13 may be adhesively or otherwise secured to a platform 10 in the same manner as the supporting members 40.

Fig. 14 shows a simplified form of the supporting member 50. Here a single strip of fiberboard 54 with the corrugations extending vertically is folded to form three sides of the tube and the end sections are slotted and intermeshed to form the criss-cross diagonal reinforcing elements 55 and 56.

In Fig. 15, the supporting member is formed of a folded rectangular sheet of fiberboard 57, again with the corrugations extending vertically, but here the lapped side wall is along the shorter side 58. The internal reinforcing elements include a folded V-shape strip 59 and a slotted and intermeshed longitudinally extending strip 60.

While each one of the units shown in Figs. 13, 14 and 15 may be utilized in and of itself as a supporting member, any one of these units may be properly dimensioned to fit within fiberboard sleeves 61, adhesively or otherwise affixed to a platform 10 as shown in Fig. 17 to provide box-like supporting members. The sleeves 61 are folded and butted corrugated paper sheets. A modification of the device at 61 is shown in Fig. 18 where, instead of being butted, the sleeves 61 have a lapped side wall 62.

Fig. 16 shows another unit which may be inserted into the sleeve 61 of Fig. 17 or Fig. 18. The unit of Fig. 16 is formed in somewhat similar manner to that shown in Fig. 11 and of similar material. Here, however, the folding forms a unit which has a base 63 and lateral extensions providing successively on each side an upright section 64, top section 65, an inside upright 66, an inside bottom section 67, and a diagonal truss 68.

Fig. 19 illustrates how a platform of Fig. 17 may have the sleeves 61 attached thereto and then may be shipped in collapsed form, accompanied by nine separate unfolded internal reinforcing units of the form of any one of those shown in Figs. 13 to 16 inclusive.

Figs. 20 to 23 illustrate pallets wherein the sleeves, instead of being separate from the platform 10 and adhesively attached thereto, as shown in the case of the pallets shown in the previous drawings, are integral with the platform 10.

In Fig. 20 the pallet comprises a central panel 10 having on each side lateral extensions providing on the left hand side a side portion 70, bottom sleeve portion 71, upright wall 72, and end panel 73; and providing on the other side similar portions 70, 71 and 72, but the portion 72 continues into a section 74, and into sections 75, 76 and 77 that form a middle sleeve, the end panel 78 of this extension butting against the end panel 73.

In each of the three sleeves is positioned a unit of the type shown in Fig. 16.

Fig. 21 is a plan view of an unfolded corrugated paper sheet, adapted to be

folded to form a device similar to that of Fig. 20 but having openings for fork lift truck entry on four instead of two sides. Here the lateral extensions 80, 81, 82, 83, 84, 85, 86, 87 and 88 of the panel 10 are cut out so that, when they are folded under the panel 10, they will leave openings therebetween. Each sleeve may have inserted therein one of the units of Fig. 16 of a length corresponding to the length of the sleeves. The sheet of Fig. 21 in folded position is shown in Fig. 23 in front elevation and in Fig. 23 in side elevation.

Figs. 24 and 25 show pallets which are each formed entirely of single integral corrugated paper sheets. In Fig. 24 a top central panel 10 has lateral extensions on each side to provide successively side panels 90, bottom panels 91 inside upright sections 92, top sections 93, inside outer uprights 94, and internal truss section 95, the top portion 96 of which is stapled in face to face relation through the top section 93 in top panel 10. The lateral extensions are spaced on each side to provide intervening openings 97 on each side of the device.

In Fig. 25 the lateral extensions extend the whole length of the pallet and the internal reinforcement is simplified by providing an end section 98 which extends diagonally from panel 93 down to the corner formed by the panels 90 and 91.

In each of the forms shown in Fig. 24 and Fig. 25 the forks of the truck enter at the ends of the pallet inside of the supporting members, whereas, in the previous forms discussed, the supporting members are spaced from each other to permit entry of the forks between the supporting members.

When devices of this invention are likely to be exposed to outdoor weather conditions, it may be advisable and it is within the contemplation of the invention to treat a portion or all of the fiberboard elements to render them waterproof or water-resistant as by the application thereto or impregnation thereof of water-repellent materials of types known to the art, such as resins, natural or synthetic rubbers, inorganic silicates, bituminous materials, coal tar or other pitches, or insolubilized glues.

It will be understood that staples, adhesives, gummed paper tapes or other fastening means may be placed at points other than those shown in the drawings in order to maintain the components in assembled condition.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A portable materials handling pallet adapted for use in lift truck operation, comprising a platform, e.g. of rectangular shape, and a plurality of tubular supporting members spaced apart from one another beneath said platform for supporting the same and consisting of non-metallic lightweight material in the form of sheets or webs, preferably of fibreboard, paper or the like, each of which supporting members extends both laterally and longitudinally of said platform a distance at least as great as its height, and which supporting members form open spaces between them or within themselves of greater width than height adequate for reception of the load-handling forks of a lifting truck beneath said platform.

2. A pallet according to claim 1, characterized in that the open spaces between the supporting members are open-bottomed.

3. A pallet according to claim 1 or 2, wherein the open spaces form mutually intersecting passageways accessible from four sides beneath said pallet.

4. A pallet according to any one of the preceding claims wherein the axial lines of the bores of the supporting members are disposed normal to the plane of the pallet.

5. A pallet according to any one of the preceding claims 1 to 3 inclusive, wherein the axial lines of the bores of the supporting members are disposed parallel to the plane of the pallet.

6. A pallet according to claim 4 wherein the supporting members are shaped as cylinders which preferably consist of spirally wound sheet material, e.g. paper.

7. A pallet according to claim 4 wherein the supporting members have circular horizontal cross sections of different diameters at different heights.

8. A pallet according to any one of the preceding claims, wherein reinforcing elements of substantially less volume than the volume of the bores of the tubular members are disposed within the supporting members to reinforce the members against lateral collapse.

9. A pallet according to claim 8 wherein the reinforcing elements have X-shaped cross section.

10. A pallet according to claim 8 or claim 9 wherein the reinforcing elements are integral with the material forming the supporting members.

11. A pallet according to claim 8 or claim 9 characterised in that the reinforcing elements have portions secured in place by fitting tightly within the walls of the supporting member.

12. A pallet according to claim 10 wherein each supporting member comprises a single sheet of corrugated fibreboard folded into an opened trussed rectangular unit presenting at least four upright sections having the corrugations thereof extending vertically and two sections extending obliquely between said upright sections.

13. A pallet according to any one of the preceding claims, wherein the supporting members are arranged in rows and the aggregate minimum plan area of the supporting members in the rows laterally and longitudinally of said platform exceeds one half the corresponding area of the platform.

14. A pallet according to any one of the preceding claims, wherein the platform and the supporting members are made integral.

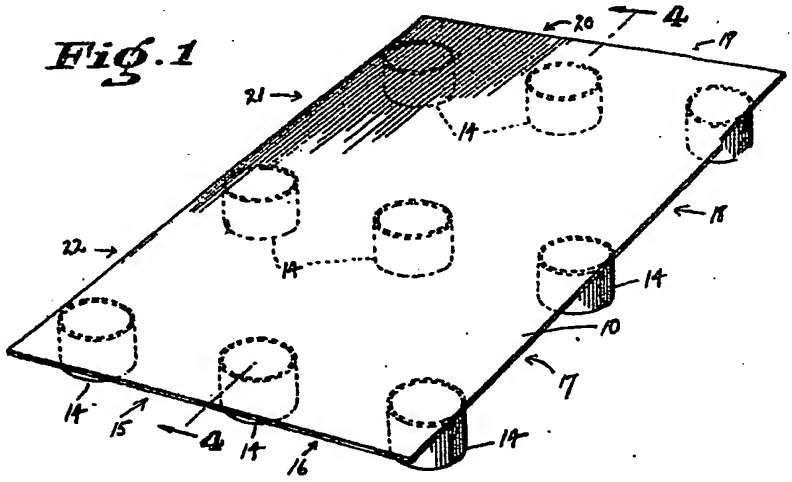
15. A pallet according to claim 15 wherein the reinforcing elements also are made integral with the platform and the supporting members.

16. A pallet substantially as described with reference to and shown in any one of the figures of the accompanying drawings.

Dated this 15th day of July, 1946.
BOULT, WADE & TENNANT,
111 & 112, Hatton Garden, E.C.1.
Chartered Patent Agents.

[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 1



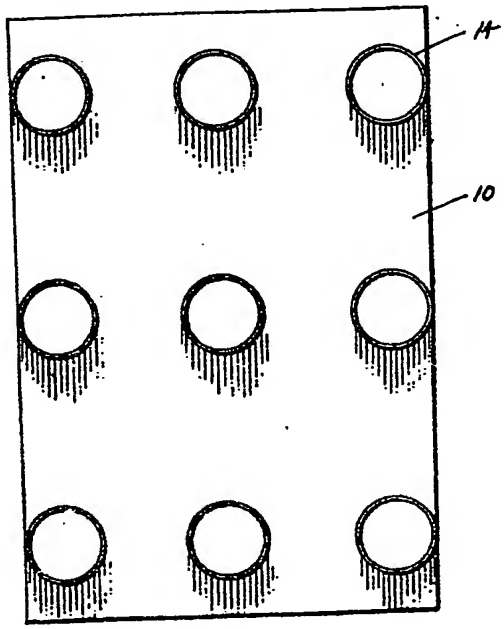


Fig. 2

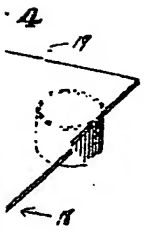
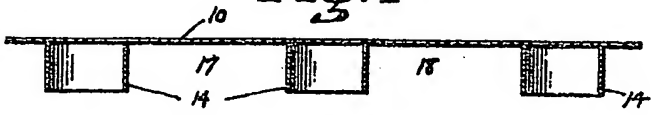


Fig. 3

Fig. 4



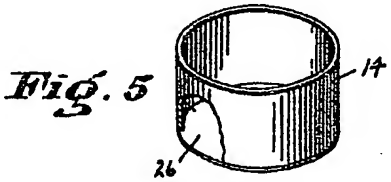


Fig. 5

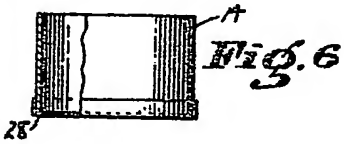


Fig. 6

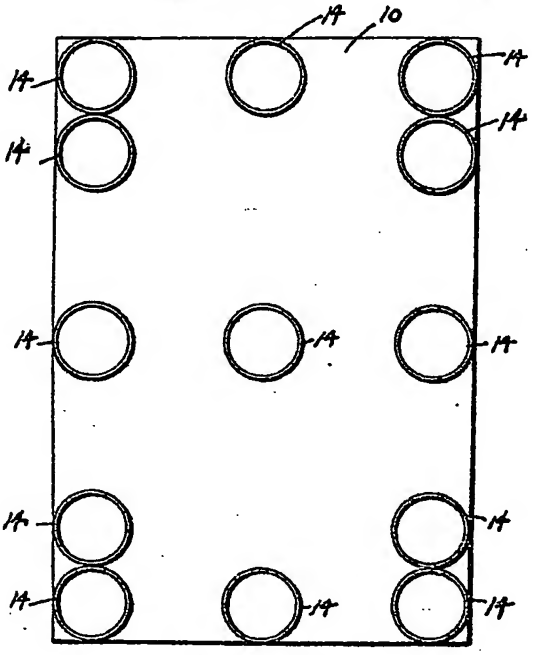


Fig. 9

Fig. 7

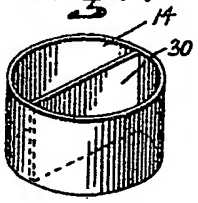
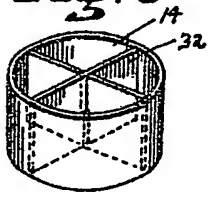


Fig. 8



6. 2

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6 SHEETS

SHEET 1

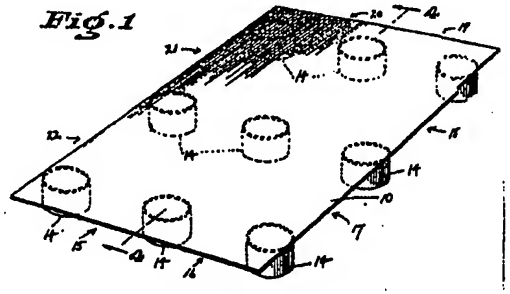


Fig. 1

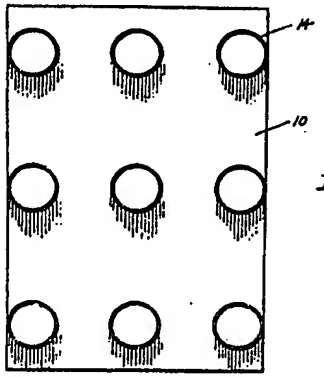


Fig. 2

SHEET 2

Fig. 3

Fig. 4

Fig. 5

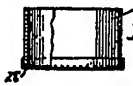


Fig. 6

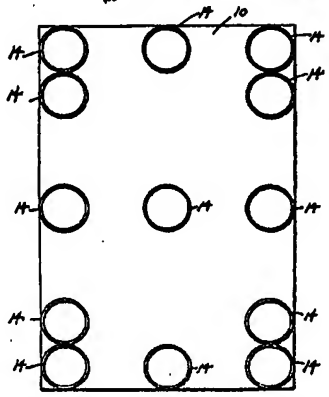


Fig. 9

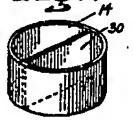


Fig. 7

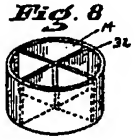


Fig. 8

This Drawing is a reproduction of the Original on a reduced scale.

H.M.S.O. (Ty.R)

Fig. 10

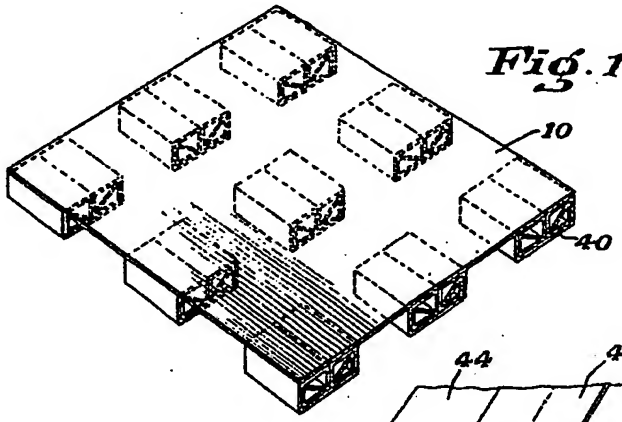
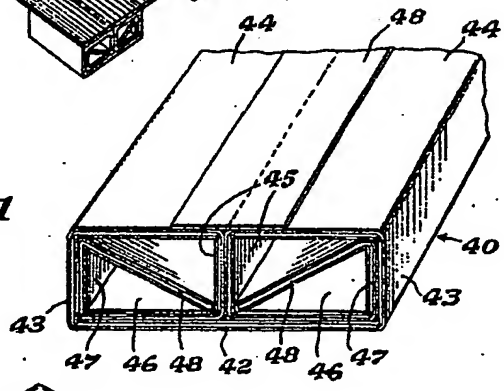


Fig. 11



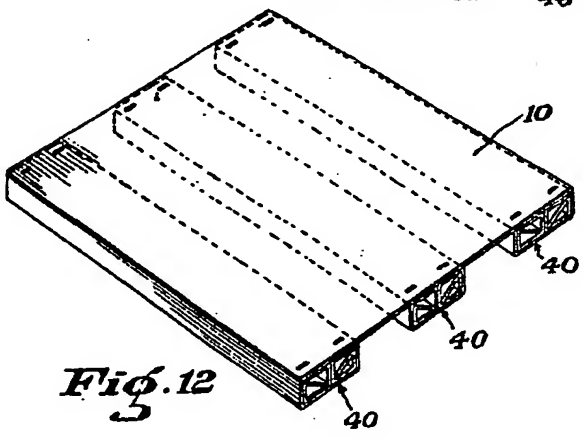


Fig. 12

3

Fig. 13

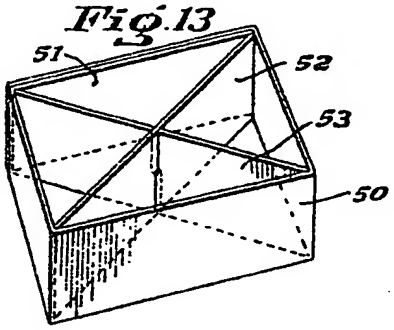


Fig. 14

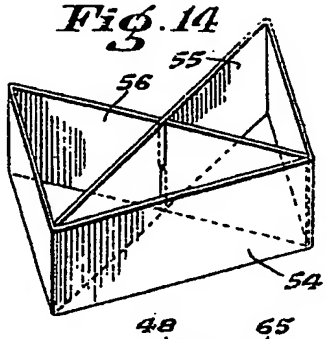


Fig. 15

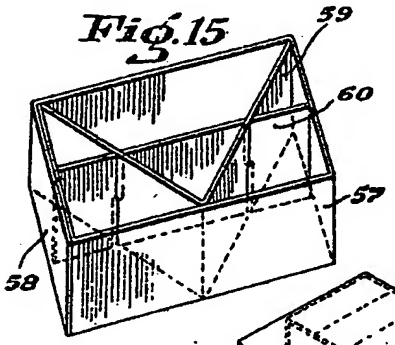
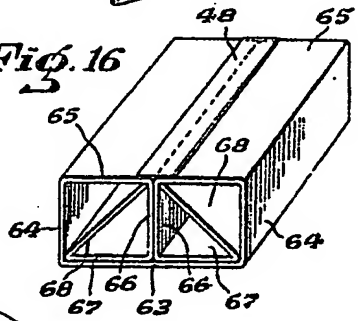


Fig. 16



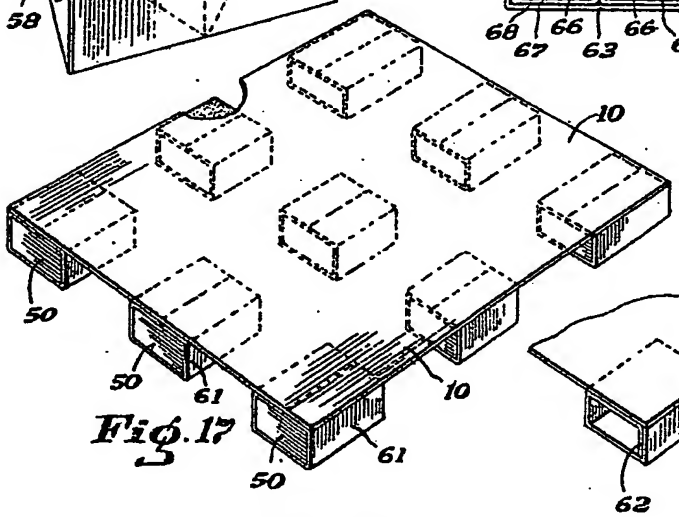


Fig. 17

Fig. 18

Fig. 19

620,701 COMPLETE SPECIFICATION

6 SHEETS

SHEET 3

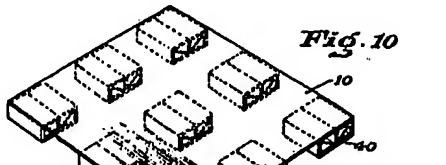


Fig. 10

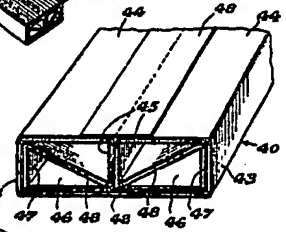


Fig. 11

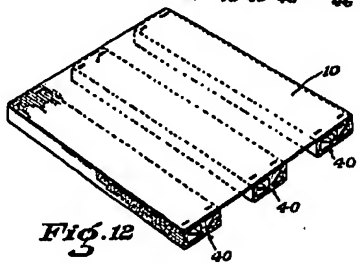


Fig. 12

[This Drawing is a reproduction of the Original on a reduced scale]

SHEET 4

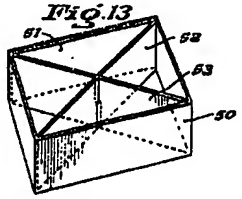


Fig. 13

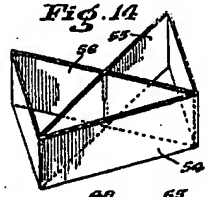


Fig. 14

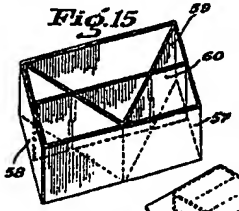


Fig. 15

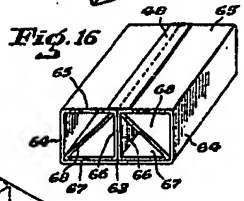


Fig. 16

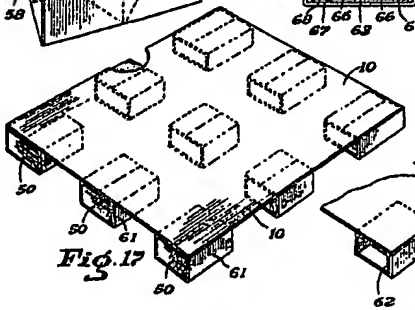


Fig. 17

Fig. 18

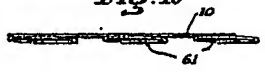


Fig. 19

H.M.S.O.(Ty.R)

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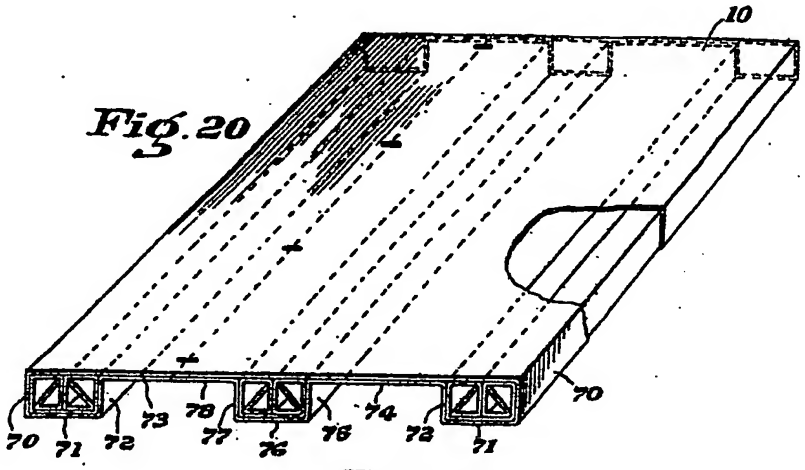


Fig. 20

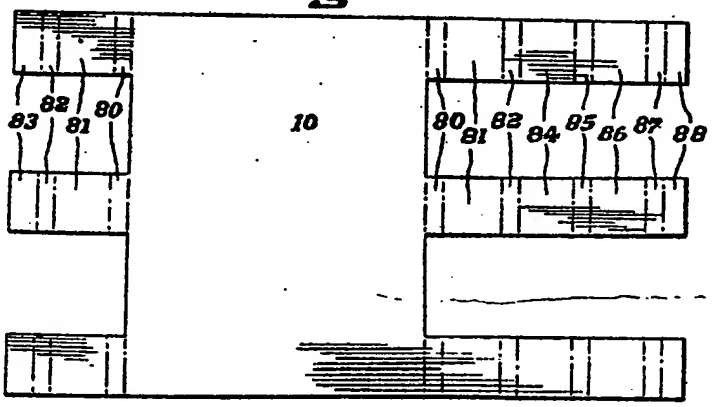


Fig. 21

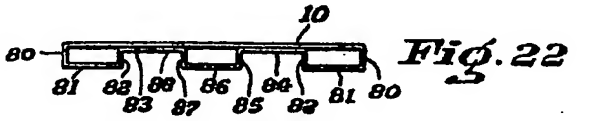


Fig. 22

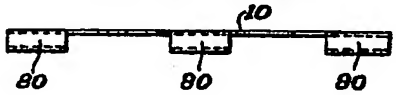


Fig. 23

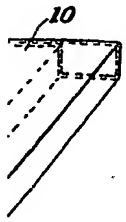
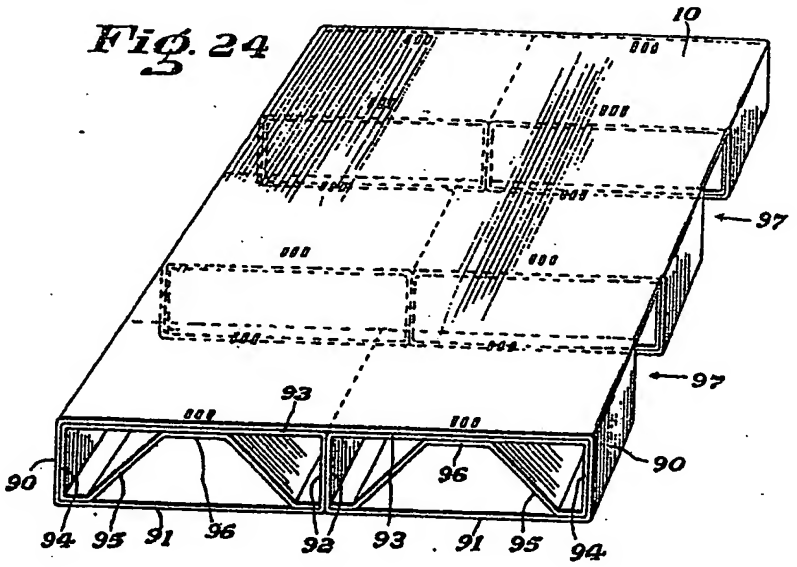


Fig. 24



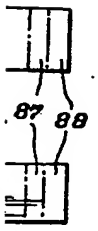
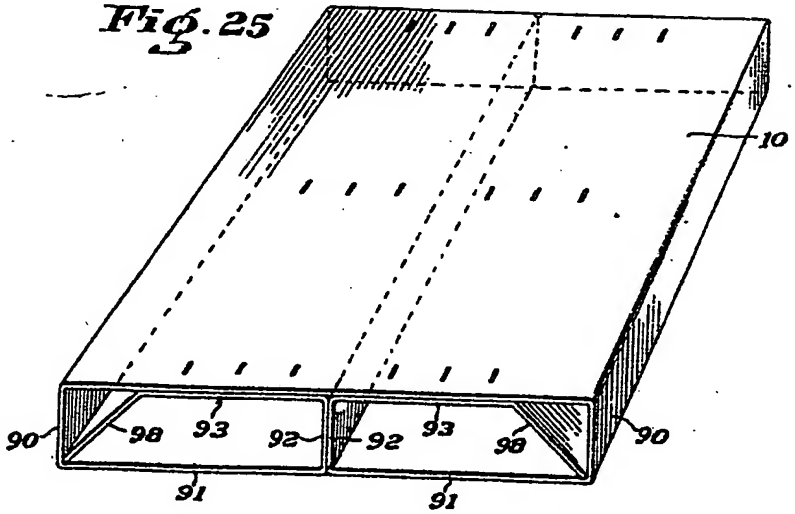


Fig. 25



3

620,701 COMPLETE SPECIFICATION

6 SHEETS

SHEET 6

[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 20

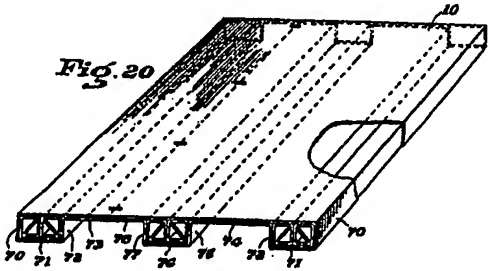
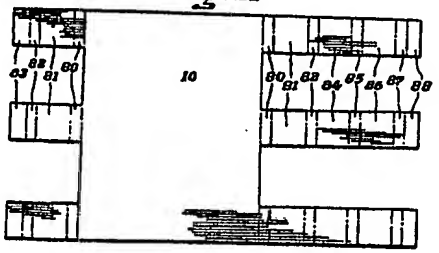


Fig. 21



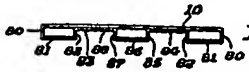


Fig. 22

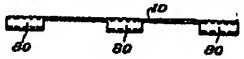
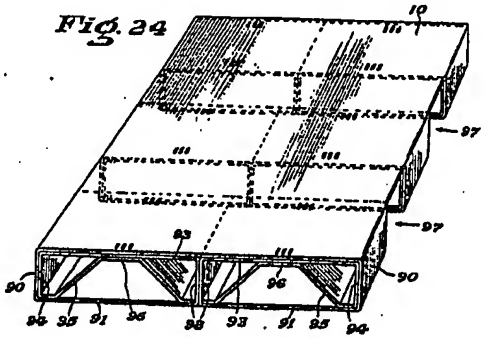


Fig. 23

Fig. 24



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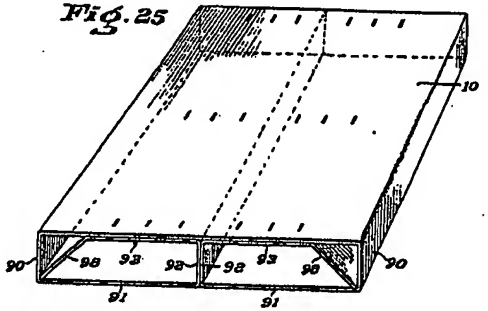

H.M.S.O. (Ty. R.)